

involved are, however, fundamental to all electrical engineering, and thus the usefulness of the book is by no means limited to the class of readers for which, to judge by the title, it has been written. The phenomena of electric wave propagation play an important part in long power-lines, and much of what the author has to tell us about the waves in telephone cables may, with some obvious modifications, be directly translated into the domain of heavy electrical work. Problems connected with propagation are most easily treated by the use of the symbolic method, and although Heaviside, Steimetz, Pupin, Kennelly, and others have for some years used this method in their publications, the majority of electrical engineering text-books still ignore it. Electrical engineers will therefore feel grateful to the author for having given them in his book a very clear and readable exposition of the treatment of electric problems by complex quantities. This is done in the first chapter. Then follows a chapter on wave propagation generally. The subject is introduced by the investigation of sound waves in air. In this way the main principles of such an investigation are established by reference to a problem with which all engineers are more or less familiar, and this is a material help to the more complicated problems of magnetic and electric waves, which are treated next.

In the third chapter we come to the general case of an infinitely long cable having at one end impressed on it an alternating e.m.f. It is this case which is of interest not only to the telephone engineer, but also to the designer of a power-line. By making use of the symbolic methods outlined in the first chapter, the author shows how the current gets weaker as we proceed from the home end, and how at the same time the phase angle between e.m.f. and current increases. He distinguishes thus between an "attenuation factor," which applies to the real part, and a "phase factor," which applies to the imaginary part of the complex quantity. In telephony the attenuation factor is not of paramount importance, since the ear is able to appreciate even very weak sounds, provided their general character as determined by the sequence of the waves of different frequency remains the same. But this is just the condition which in an ordinary telephone cable only exists if its length is moderate. The phase factor is different for each wave-length, and thus the longer the line the greater is the distortion in the arriving waves. A moderate amount of distortion the human ear is able to analyse, in the same way as we are able to recognise a person's face from a caricature if the distortion of the true features is moderate, but on very long lines the attenuation and phase factors have so altered the character of the waves that the ear is no longer able to analyse them, and telephony becomes impossible.

This refers to an ordinary cable in which there is little inductance, but much capacity. The author shows that the old rule according to which the product of capacity and resistance was considered, the important item on which clearness of speech depended, is wrong, and that, as was first pointed out by Heaviside, the condition for perfect transmission is equality

between two products, namely, that of capacity and resistance per mile and that of inductance and leakage per mile. In a cable of this kind the velocity of propagation is the same for all frequencies, and consequently all parts of a composite wave travel at the same speed and arrive without distortion, although, of course, attenuated. Heaviside called a cable of this kind a "distortionless cable."

By reference to Pupin's theory it is next shown how an approach to the perfection of such a cable may be obtained by "loading," that is, putting inductances at intervals along the line in series with the conductor. This approach to perfection will obviously be the closer the more it approaches the condition of a uniformly loaded line. This means that the impedance coils must not be too far apart. Eight to nine coils per wave-length is the number theoretically found in an example given of a 90 ohms per mile line, where coils of 0.2 henry every two miles satisfy this condition. In the Anglo-French telephone cable laid by the British Post Office last year the impedance coils have each an inductance of 0.1 henry, and are spaced 1.53 miles apart. The construction of this cable is fully described. There is also a chapter devoted to submarine telegraphy, and another to the study of the propagation of waves of very high frequency along wires. Here, again, the power engineer will find much useful information.

GISBERT KAPP.

MARINE REFRIGERATION.

Cold Storage, Heating, and Ventilating on Board Ship. By Sydney F. Walker, R.N. Pp. vi+269. (London: Constable and Co., Ltd., 1911.) Price 8s. net.

THE increasing luxury of modern sea-travel makes the use of cold storage almost a necessity for any but the smallest passenger boats. In the large liners the most elaborate arrangements are used to preserve the food and to keep a continual flow of air at the proper degrees of temperature and dryness through the passenger regions. In this book the author has brought together the general principles which must be used to get such a result, and in the section on cold storage considers the principal methods used to convey the enormous quantity of food now brought to this country in cold storage.

An improvement would be an index, especially to designers and freezer engineers, for whom the book is primarily intended, as it is not easy to find if a reference is made to any particular fitting or arrangement. It is well known, for instance, that there are two distinct methods of treatment suitable for different kinds of food. In one, so soon as the natural heat has gone out, the food is frozen to some degrees below freezing-point, and maintained frozen—but at no particular temperature—until ultimately thawed for use; in the other, the food is never frozen, but is maintained at as constant a temperature as possible a few degrees above freezing-point, and in an atmosphere with a definite degree of humidity. There is no difficulty about the first method, which is used, for instance,

for mutton; but in the latter, used for beef, fish, and fruit, the constancy both of the temperature and the humidity is most important. There are at the present time various devices for maintaining the constancy of these factors more or less automatically, so as to relieve the operating staff from the continual strain of watching gauges, but no reference seems to be made to them.

Again, the advantages of the various methods for producing cold are given, but no attempt at summarising the knowledge so that a marine engineer could easily determine which system would be the most suitable for his particular case.

Considerable attention is paid to the discovery and prevention of faults in the whole storage system, and the advice given would doubtless be of great use to the freezer engineer. In the sections on ventilating and heating, which are clearly to be taken together, the various methods in use are considered in some detail. The author obviously inclines to electrical methods, which certainly have the great advantage that the transference of air and the generation of heat can be far more easily controlled at a large number of points. An interesting calculation is made as to the expense of running electric heating on a large liner, and appears to show that the cost is quite disproportionate to the extra comfort obtained.

There are some curious instances of the inclusion of really extraneous matter, such as the question of ventilation in mines, where the problem is essentially different and the presence of poisonous or explosive gases makes the failure of the ventilation a cause of real danger and not merely of discomfort.

In the heating section also there are a large number of illustrations of electric heaters differing very little, and more suitable to a catalogue. The book is well illustrated, and should find a distinct place in the literature of the subject.

F. H.

RADIOGRAPHY.

Disease in Bone and its Detection by the X-Rays.

By E. W. H. Shenton. Pp. xii+72+46 figures. (London: Macmillan and Co., Ltd, 1911.) Price 4s. 6d. net.

MR. E. W. H. SHENTON was one of the first medical men to take up the use of the Röntgen-rays for the purposes of medical diagnosis. His experience extends to more than fourteen years, and thus dates back almost to the time of the publication of Prof. Röntgen's discovery. Mr. Shenton points out in his preface the necessity for skill in carrying out the examinations and in interpreting the results. Many laymen are able to take "clear" X-ray photographs, but only an expert can be sure of taking photographs in the best way for obtaining the maximum diagnostic information. The final words of Mr. Shenton's preface are—

"To the staff of Guy's Hospital I owe more than I can acknowledge here, but for nothing am I more grateful than their attitude towards the whole subject of X-ray work. In my opinion, it has raised radiography from a branch of photography to a branch of practical medicine. As a pioneer I might have had the rough time pioneers look for, but my way has

been considerably smoothed by their generous encouragement."

In the diagnosis of diseases and injuries of bones, changes of form or of density are those chiefly concerned, for opacity to X-rays is a function of density. Mr. Shenton makes the helpful general statement that acute bone disease is made evident by increase of transparency, and chronic disease by increase of opacity. He warns us against the common error of mistaking apparent variations in density of bone, due to the condition of the X-ray tube, for actual variations in density. The exposure should be such as to give the greatest possible amount of detail of texture of the bones, and a "very clear" skiagram, where the contrast between the bones and the soft parts is extremely sharp, is usually lacking in detail of bone texture.

Mr. Shenton goes fully into the subject of fracture, and directs especial attention to the subject of "callus," the new material formed around fractures, uniting the fragments. When first formed this callus is entirely transparent to the X-rays. This is a very fortunate fact, as otherwise we should not be able to judge the nature and extent of a bony lesion except just after its occurrence; not for many weeks as we are able to do. The author directs special attention also to the absence of unnecessary callus in fractures treated by Mr. W. Arbuthnot Lane's method of bringing the fragments into accurate apposition by metal plates and screws.

Various diseases of bone—abscesses, tumours, and inflammatory diseases—are described and illustrated, as are also the rheumatic and gouty conditions which affect bones in the proximity of joints. The appearance of the teeth in normal and abnormal conditions is illustrated and described.

The book is full of information, the result of the author's almost unequalled experience. It is beautifully printed in large clear type on art paper, so that the illustrations show to the best possible advantage.

A. C. J.

OUR BOOK SHELF.

A Text-book of Elementary Foundry Practice for the Use of Students in Colleges and Secondary Schools.

By W. A. Richards. Pp. xii+121. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1910.) Price 5s. 6d. net.

THAT a text-book of elementary foundry practice should be required for the use of students in secondary schools reads strangely in this country, but indicates how far trade practice is being brought into school curricula in the United States; and this work is by the instructor in forge and foundry practice in the University High School and the University, Chicago. A careful perusal of the book shows that it is the practice of the foundry—and that mainly of moulding—that is treated of, and not the science underlying foundry work. Only hand tools and such moulding as can be done with them are described, and the making of moulds for the production of steel castings is not included.

The author claims that though his book is written for boys in secondary schools, he hopes it may suit the college student, and that it is so plain and practical that it may be used without an instructor. A